Bharath

INSTITUTE OF HIGHER EDUCATION AND RESEARCH

(Declared as Deemed-to-be-University under section 3 of UGC Act 1956)

A GRADE ACCREDITED BY NAAC — NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL

173, Agaram Road, Selaiyur, Chennai - 600 073. Tamil Nadu, India.

RECORD NOTE BOOK

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Year / Sem.: 1st Year / 2nd Sem

Branch: ECE

Subject: Physics

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Course: B.TECH Branch: ECE

Year: first Semester: 2nd

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Certified to be the bonafide Record of work done by the above student in the Physics practical laboratory during the 1st & 2nd Semester in the Academic year 2018 - 2019.

Signature of the Lab-in-charge

Signature of the Head of Dept.

Submitted for the practical examination held on 17-05-2019

Internal Examiner

External Examiner

INSTRUCTIONS FOR MAINTAINING THE RECORD NOTE BOOK

1. The Record should be written neatly in ink on the pages of the right hand side and the diagrams /drawings to be drawn on the pages of the left hand side in pencil.

2. Every Experiment should begin on a new page.

3. The right hand side pages of the record should contain:

   i. SI. No. and date of performance of the Experiment in the margin at the top.

   ii. Experiment No. and the title of the Experiment on the first line followed by

   iii. Aim of the Experiment.

   iv. A list of apparatus required.

   v. Description of the apparatus.

   vi. Theory of the Experiment in brief.

   vii. Inference of the result.

4. The left hand side pages of the Record should contain :

   i. Neat sketches of apparatus used and full page graphs wherever possible.

   ii Diagrams of Electrical connections neatly drawn.

   iii. Observation (to be entered in a tabular form neatly, wherever possible)

   iv. A detailed account of manipulation.

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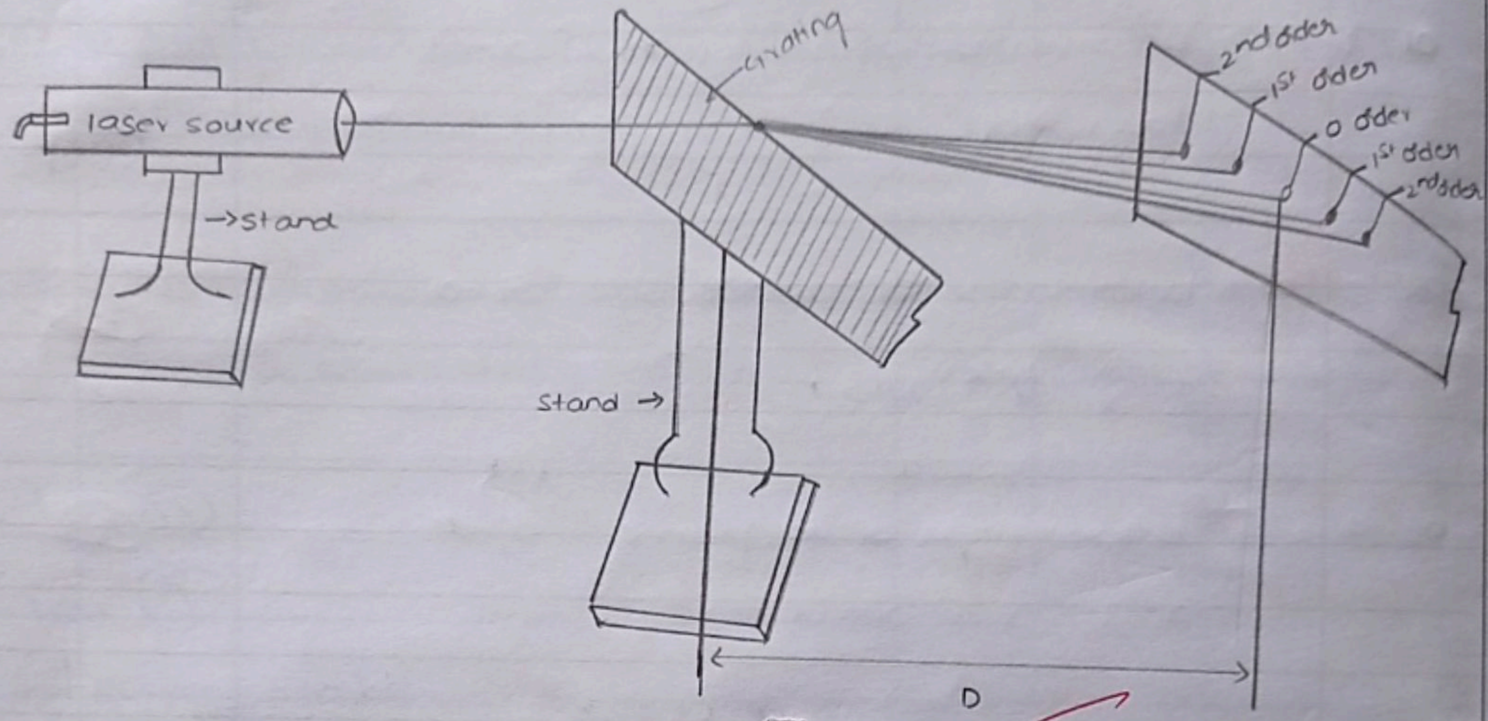
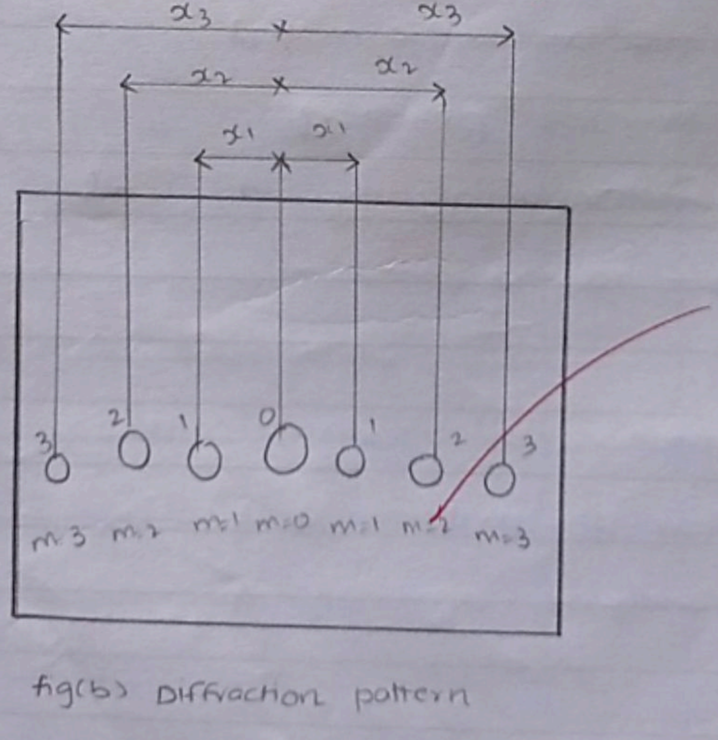




fig(b) Diffraction pattern

DETERMINATION OF WAVELENGTH OF LASER LIGHT

Aim:-

To determine the wavelength of the given laser light using grating.

Apparatus required:-

* laser light source
* Grating
* screen
* Half meter scale.

formula:-

The wavelength of the given laser light,

$$\lambda = \frac{\sin\theta}{Nm} \, m$$

explanation of symbols:-

Symbol	explanation	unit
θ	Angle of diffraction	degree
m	order of diffraction spots.	
N	Number of lines per meter in grating	lines/m.

i, calculation of number of lines per metre (N) in grating.

laser grating normally consists 2500 lines per inch

$1 \text{ inch} = 2.54\,cm = 2.54 \times 10^{-2} m.$

$2.54 \times 10^{-2} m$ contains 2500 lines

1m contains $\frac{2500 \times 10^2}{2.54} = 98425$ lines

$\therefore N = 98425$ lines/m.

ii, Determination of wavelength of laser light.

Number of lines/m in the grating (N) = 10^5 lines/m

Distance between the grating and screen = 45.5 cm

S NO	order of diffraction	Distance of different spots from the central Spot (xcm)			$\tan\theta = x_m/D$	$\theta = \tan^{-1} x_m/D$	$\lambda = \frac{\sin\theta}{Nm}$ m
unit	(m)	left cm	right cm	mean cm.		degree	m.
1.	1	2.9	2.9	2.9	0.0637	3.6448	6.355×10^{-7}
2.	2	5.9	5.9	5.9	0.1296	7.3843	6.426×10^{-7}
3.	3	8.9	8.9	8.9	0.1956	11.0673	6.396×10^{-7}
4.	4	12.2	12.2	12.2	0.2681	15.0080	6.473×10^{-7}
5.	5	15.4	15.4	15.4	0.3384	18.6958	$6 \times 4108 \times 10^{-7}$
6.	6						

mean = 6.412×10^{-7}

= 6412 A^0

procedure:-

The experimental set-up for the determination. of the wavelength of the given laser light using granting is shown in fig(a). The laser source is kept horizontally extreme care should be taken to avoid direct exposure of eyes to laser light. The grating is held normal to the laser beam. A screen is placed on other side of grating.

laser light source is switched on for the nórmal incidence of laser beam on the grating is adjusted for such that the reflected laser beam from the grating coincides with the beam coming out of the laser source. Now the diffraction pattern in the form of circular spots is observed on the screen. The diffraction pattern consists of central spot followed by a number of spots on either side of the central gets as shown in fig(b). The different spots etc. The distance (x_m) of the different spots on either side from the central spot are measured using scale. The distance between the grating and screen (D) is also measured.

The value θ is calculated using the following expression,

$$\theta = \tan^{-1} x_m/D$$

and wavelength of the given laser light is calculated using the formula,

$$\lambda = \frac{\sin\theta \; m}{N_m}$$

Calculation

1) $\lambda = \frac{\sin\theta}{Nm}$

$\lambda = \frac{\sin(3.644)}{10^5 \times 1} = \frac{0.6355}{10^5} = 6.355 \times 10^{-7}$ Åm

2) $\lambda = \frac{\sin(7.3843)}{10^5 \times 2} = \frac{0.12852}{10^5 \times 2} = 6.426 \times 10^{-7}$ m

3) $\lambda = \frac{\sin(11.0673)}{10^5 \times 3} = \frac{0.19196}{10^5 \times 3} = 6.396 \times 10^{-7}$ m

4) $\lambda = \frac{\sin(15.0080)}{10^5 \times 4} = \frac{0.25895}{10^5 \times 4} = 6.473 \times 10^{-7}$ m

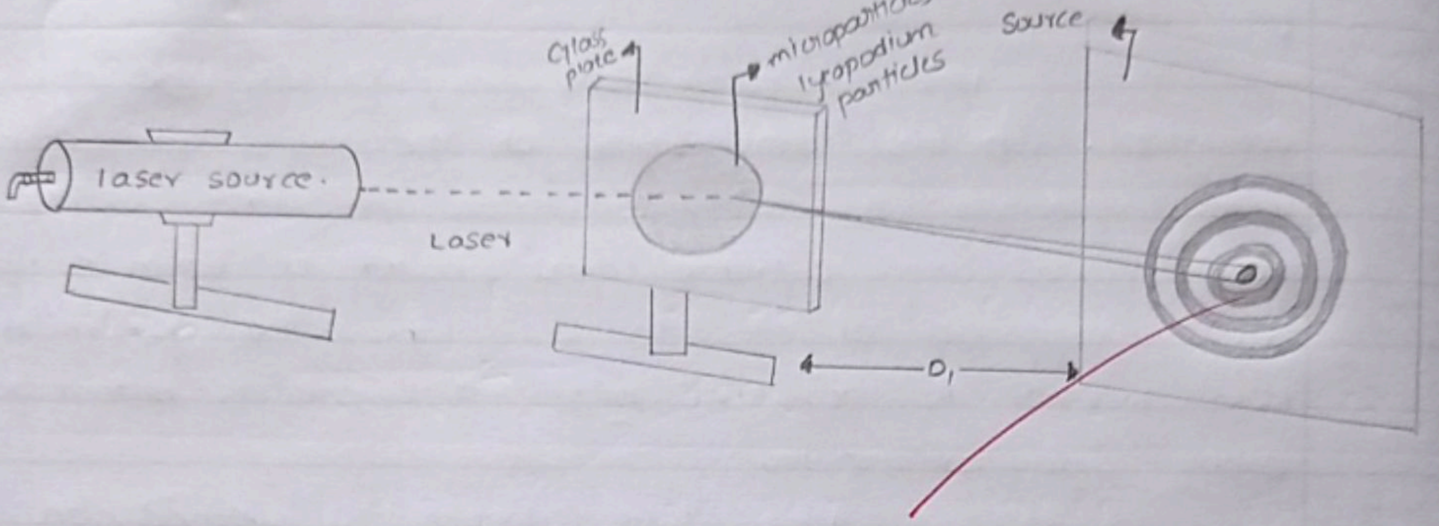
5) $\lambda = \frac{\sin(18.6958)}{10^5 \times 5} = \frac{0.32054}{10^5 \times 5} = 6.4108 \times 10^{-7}$ m.

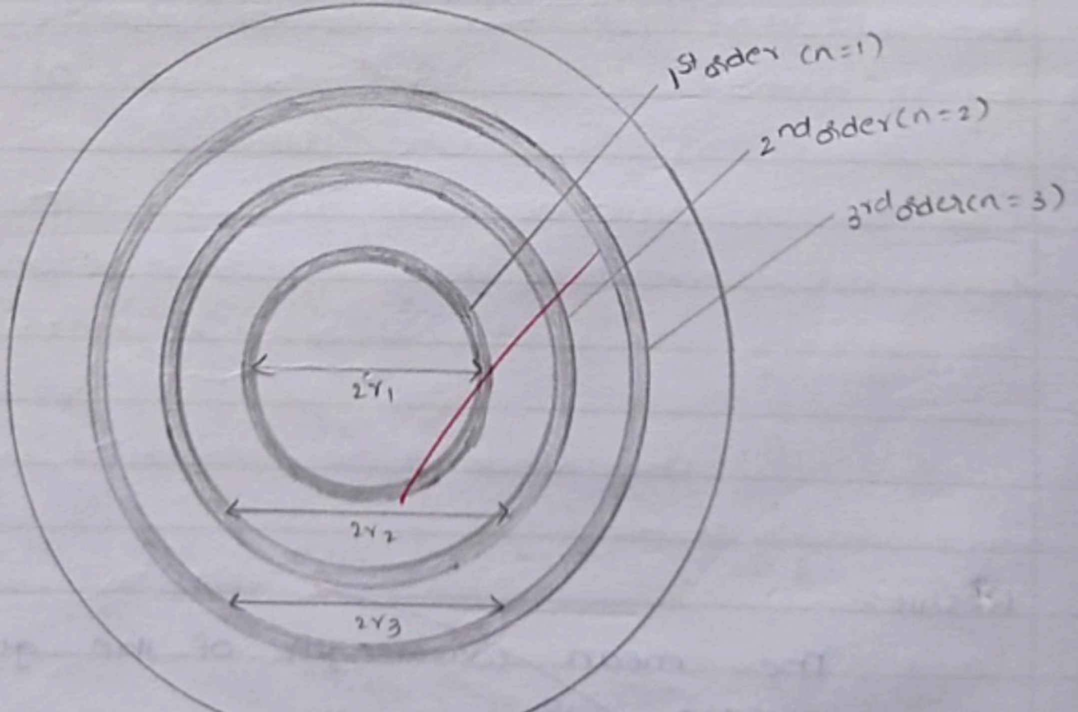
Result:-

The mean wavelength of the given laser light

= 6412 A°

Fig(a):- experimental st-up to produce diffraction circular rings for determing the particle size.





fig(b). diffraction pattern - circular rings

DETERMINATION OF PARTICLE SIZE USING LASER

Aim:-

To determine the size of the given microparticles present in the lycopodium power using laser light

Apparatus required:-

* Laser source
* Lycopodium powder with fine microparticles
* Glass plate
* Screen
* Half meter scale.

formula:-

The size (diameter) of the given particles

$$d = \frac{n \lambda D_1}{x_n} \text{ metre.}$$

explanation of symbols:-

Symbol	explanations	unit.
n	order of diffraction	
λ	wavelength of laser light used	metre.
D_1	distance b/w the glass plate and screen	metre
x_n	Radii of different order dark rings	metre.

Determination of particle size:-

wavelength of laser light used $\lambda = 6900 \times 10^{-10}$ m

SNO	Distance b/w the screen and glass plate	order of circular rings	Diameter of n^{th} dark ring	Radii of n^{th} dark ring	particle size $d = \frac{n\lambda D_1}{x_n}$
unit	cm	–	cm	cm	m
1	10.5	1	$20 (2x_1)$	$10 (x_1)$	$7,245 \times 10^{-10}$
2		2	$40 (x_2)$	$20 (x_2)$	$7,245 \times 10^{-10}$
3					
1	18.5	1	$30 (2x_1)$	$15 (x_1)$	$8,530 \times 10^{-10}$
2		2	$68 (2x_2)$	$34 (x_2)$	$7,508 \times 10^{-10}$
3					
1	23	1	$40 (2x_1)$	$20 (x_1)$	$7,935 \times 10^{-10}$
2		2	$80 (2x_2)$	$40 (x_2)$	$7,935 \times 10^{-10}$
3					

Mean = 7.7298 μm.

calculation:-

(i) $D_1 = 10.5$ cm $\lambda = 6900 \times 10^{-10}$ m.

1. for $n = 1$ $x_n = x_1 = $ cm $= 10$ cm.

$$d = \frac{\lambda \times D_1}{x_1} = \frac{1 \times 6900 \times 10^{-10} \times 10.5 \times 10^{-2}}{10 \times 10^{-2}} = 7245 \times 10^{-10} \text{ m.}$$

procedure:-

The experimental set-up to produce diffraction pattern (circular rings) for determining the particle size is shown in fig (a) The glass plate is cleaned well and fine lycopodium powder of particle size in the range of micrometer is sprinkled uniformly over the glass plate. The glass plate is placed between the laser source and the screen. The laser source is switched on and light is made to fall on the glass plate. Now, the laser gets diffracted by the particles present on glass plate.

The distance between the glass plate and the screen is adjusted until a clear image of circular rings pattern is obtained on the screen as shown in fig(b) The distance between the glass plate and the screen is measured as D_1. The diameters of the dark rings of different orders ($n = 1, 2, 3 \dots$) are measured as $2x_1, 2x_2, 2x_3 \dots$ using a half metre scale. The radii of the dark rings are then calculated as $x_1, x_2, x_3 \dots$ The particle size is calculated using the formula.

$$d = \frac{n \lambda D_1}{x_n} \text{ m}$$

The experiment is repeated for various values as D_1 and the mean value of particle size is calculated

2. for $n=2$

$$d = \frac{2\lambda \times D_1}{x_2} = \frac{2 \times 6900 \times 10^{-10} \times 10.5 \times 10^{-2}}{2.0 \times 10^{-2}} = 7245 \times 10^{-10}$$

(i) calculation

$n=1$, $d=18.5$, $x_n=15$

$$d = \frac{1 \times 18.5 \times 6900 \times 10^{-10}}{15}$$

$= 8.510 \times 10^{-10}$ m.

(i) $n=2$, $d=18.5$ $x_n = 34$

$$d = \frac{2 \times 18.5 \times 6900 \times 10^{-10}}{34}$$

$= 7.50083 \times 10^{-5}$ m.

(ii) (i) $n=1$ $d=23$, $x_n=20$

$$d = \frac{1 \times 23 \times 6900 \times 10^{-10}}{20}$$

$= 7,935 \times 10^{-5}$ m

(ii) $n=2$, $d=23$, $x_n=40$

$$= \frac{2 \times 23 \times 6900 \times 10^{-10}}{40}$$

$= 7935 \times 10^{-10}$ m.

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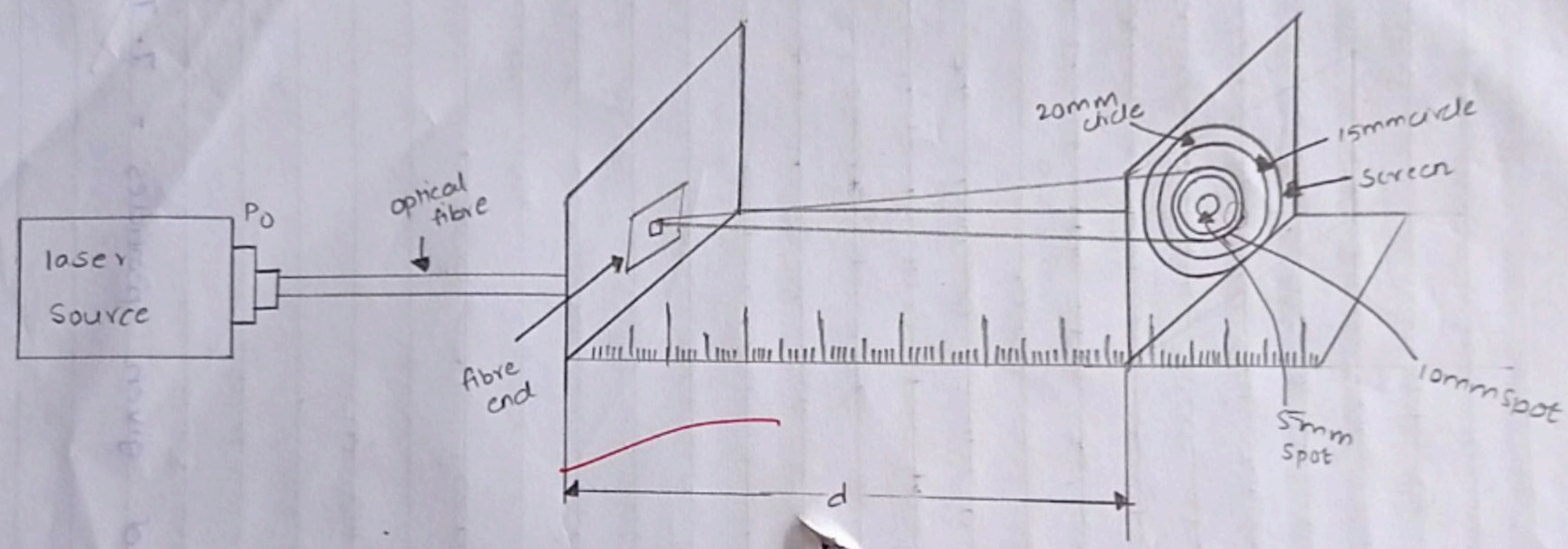
Result:-

The average size of given particles = $7.7298\ \mu m$



Fig(a): experimental set-up for the measurement of numerical aporature and Acceptance angle.

DETERMINATION OF ACCEPTANCE ANGLE OF A OPTICAL FIBRE.

Aim:-

To determine the numerical sprecture and acceptance angle of given optical fibre.

Apparatus required:-

* laser light source
* optical fibre cable.
* Numerical operature jig
* Screen with concentric circles
* half metre scale.

formula:-

i, Numerical aperature ; $NA = \sin\theta_a = \frac{r_n}{\sqrt{r_n^2+d_n^2}}$

ii, acceptance angle ; $\theta_a = \sin^{-1} NA$ degree.

explanation of symbols:-

Symbol	explanation	unit
r_n	Radius of the n^{th} illuminated circular image	mm
d_n	Distance b/w the fibre end and the screen with concentric circular image	mm

Determination of numerical aperature and acceptance angle

SNO	order (n)	Distance b/w the fibre and screen(d_n)	Radius of circular image (r_n)	numerical aperature $NA = \frac{r_n}{\sqrt{r_n^2+d_n^2}}$	Acceptance angle $\theta_a = \sin^{-1} NA$
unit		mm	mm		degree
1	1	15	2.5	0.164	9.43°
2	2	22	5	0.221	12.76°
3	3	24	7.5	0.298	17.33°
4	4	29	10	0.326	19.02°
5	5	31	12.5	0.373	21.9°
6	6	39	15.0	0.358	20.97°

Mean = 0.285 mean = 16.65de

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procedure:-

The experimental set-up for the measurement of numerical aperature and acceptance angle of a given optical fibre is shown in fig. one end of the optical fibre is connected to a laser source and the other end is connected to a numerical Aperature jig (NA jig). The NA jig is provided with a screen consisting of concentric circles. The successive concentric circles are marked with increasing diameters starting from the first circle as 5mm, 10mm, 15mm etc. A horizontal scale is also provided to measure the distance b/w the fibre end and the screen.

The laser source is switched on. By adjusting the position of the screen, the first circle of diameter 5mm is uniformly illuminated with red patch of light. The radius of first circle is measured as r_1 using a half meter scale and the corresponding distance of the screen from the fibre end is measured as d_1 using the horizontal scale. Then, the numerical Aperature (NA) and the acceptance Angle (θ_a) are calculated using the following formula.

$$NA = \frac{r_1}{\sqrt{r_1^2+d_1^2}}$$

$$\left[\because NA = \frac{r_n}{\sqrt{r_n^2+d_n^2}} \quad \text{Here } n=1 \right]$$

and $\theta_a = \sin^{-1} NA$ degree.

The experiment is repeated by moving the screen so that the remaining concentric circles of diameters 10mm, 15mm, 20mm etc. are illuminated successively with uniform brightness. The radii r_2, r_3, r_4 etc. of the circles and the corresponding distances d_2, d_3, d_4 of the screen from the fibre end are measured respectively.

calculation:-

$N_1 = \frac{r_1}{\sqrt{r_1^2+d_1^2}} = \frac{2.5}{\sqrt{(2.5)^2+(15)^2}} = 0.164 \Rightarrow \theta = 9.43^\circ$

$N_2 = \frac{r_2}{\sqrt{r_1^2+d_1^2}} = \frac{5}{\sqrt{(5)^2+(15)^2}} = 0.221 \Rightarrow \theta = 12.76^\circ$

$N_3 = \frac{r_3}{\sqrt{r_3^2+d_3^2}} = \frac{7.5}{\sqrt{(7.5)^2+(15)^2}} = 0.298 \Rightarrow \theta = 17.35^\circ$

$N_4 = \frac{r_4}{\sqrt{r_4^2+d_4^2}} = \frac{10}{\sqrt{(10)^2+(15)^2}} = 0.326 \Rightarrow \theta = 19^\circ$

$N_5 = \frac{r_5}{\sqrt{r_5^2+d_5^2}} = \frac{12.5}{\sqrt{(12.5)^2+(15)^2}} = 0.373 \Rightarrow \theta = 21.9^\circ$

$N_6 = \frac{r_6}{\sqrt{r_6^2+d_6^2}} = \frac{15}{\sqrt{(15)^2+(15)^2}} = 0.358 \Rightarrow \theta = 20.9^\circ$

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Then $NA = \frac{r_2}{\sqrt{r_2^2 + d_2^2}}$ (Here n=2)

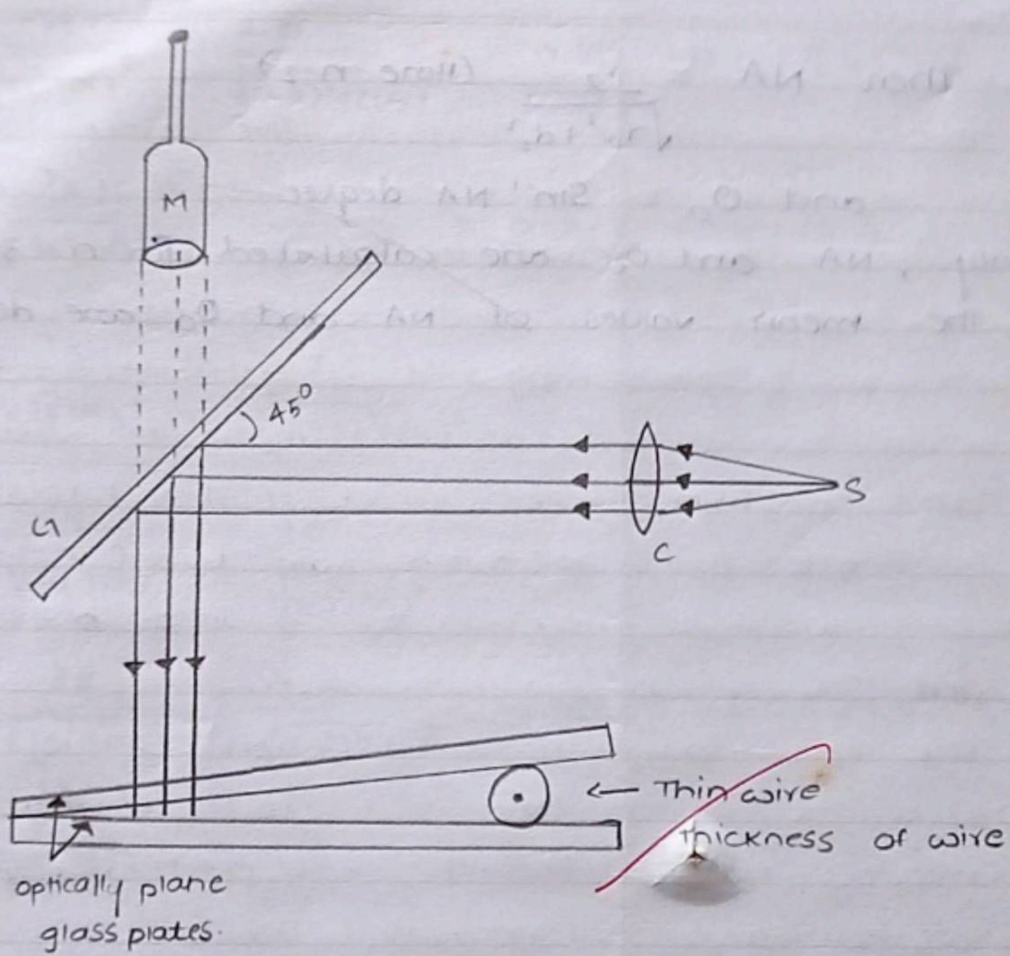
and $\theta_a = \sin^{-1} NA$ degree

Similarly, NA and θ_a are calculated for n = 3,4,5 etc and the mean values of NA and θ_a are determined

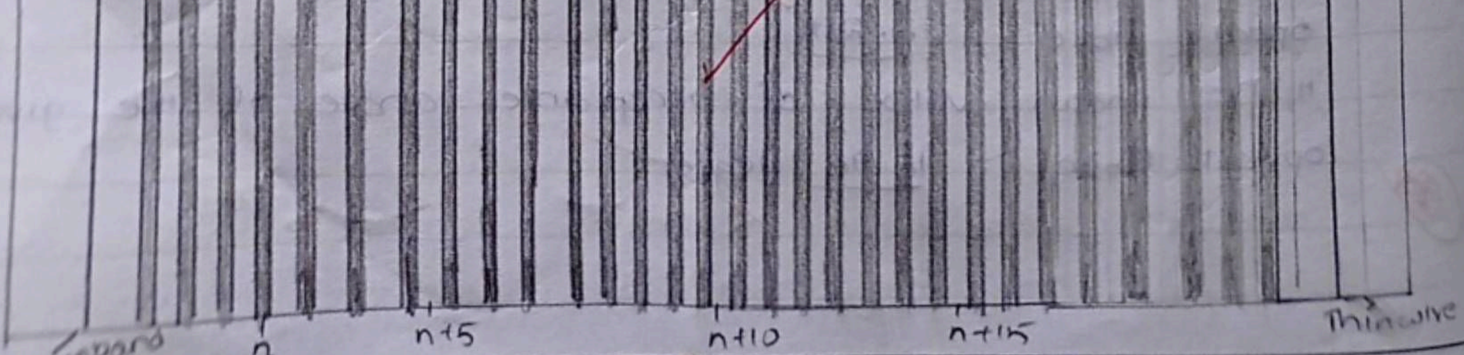
Result:-

i, The mean value of Numerical aperature of the given optical fibre = 0.285

ii, The mean value of acceptance angle of the given optical fibre = 16.90 degrees fig(a): Air-wedge - experimental set-up.



fig(b): interferance pattern - Alternate bright and dark straight bands



DETERMINATION OF THICKNESS OF A THIN WIRE AIR WEDGE METHOD

Aim:-

To determine the thickness of a given thin wire by forming interferance frenges using air-wedge method

Apparatus required:-

* travelling microscope.
* Sodium vampour lamp
* Two Optically plane rectangular glass plates
* condensing lens
* Reading lens
* Given thin wire.

formula:-

The thickness of the given thin wire, $t = \frac{\lambda l}{2\beta}$ m.

explanation of the symbols:-

Symbol	explanation	unit.
λ	wavelength of Sodium light	metre
l	dis b/w edge of contact and wire	metre
β	Bandwidth	metre.

i) least count of the travelling microscope :-

least count = 1 MSD − 1 VSD.

$\doteq$ 20 MSD = 1 cm

$$1 MSD = \frac{1}{20} cm = 0.05 cm$$

50 MSD = 49 MSD

= 49×0.05 cm

$$1 VSD = \frac{49 \times 0.05}{50} = 0.049$$

LC = (0.05 − 0.49) cm = 0.001 cm.

ii) Determination of bandwidth :-

LC = 0.001 cm.

SNo	order of the dark band	microscope readings				width of 15 dark bands	Bandwidth
		MSR	VSC	VSR = VSC×LC	TR = MSR + VSR		
Unit		cm	div	cm	cm	cm	cm
1	n	7.45	4	4×0.001	7.404	0.049	0.098
2	n+5	7.35	5	5×0.001	7.355	0.049	0.098
3	n+10	7.30	6	6×0.001	7.306	0.055	0.11
4	n+15	7.25	1	1×0.001	7.251	0.048	0.096
5	n+20	7.20	3	3×0.001	7.203	0.048	0.096
6	n+25	7.15	4	4×0.001	7.154	0.049	0.098
7	n+30	7.10	2	2×0.001	7.102	0.052	0.0104
8	n+35	7.05	7	7×0.001	7.057	0.045	0.009

Mean (β) = 0.017 cm

$= 0.017 \times 10^{-2}$ m

procedure:-

Two optically plane glass plates are held firmly together at one end with the help of a rubber band The given wire is placed at the other end. Now, an air-film of varying thickness is formed between the two glass plates. Thus arrangement is called air-wedge. The experimental set-up is shown in fig(a)

light from a Sodium lamp(s) is rendendred parllel by a convex lens (c). The parllel rays of light fall on a glass plate(G) linclined at 45° to the horizontal bed of a travelling microscope. The light reflected from the glass plate falls vertically on the air-wedge. interferance takes place between the rays of light reflected from top and lower surfaces of the air film between ~~the~~ rays the light plane glass plates. Alternate bright and dark straight bands are formed depending upon the path difference between the light rays. The microscope is focussed on the interferance bands. The fine adjustment screw at the side. The main Scale reading and the corresponding vernier scale coincidence are noted. The total microscope reading is then calculated

$$TR = (MSR + VSR)\,cm.$$

where $VSR = (VSC \times LC)$

The observations are repeated for n+5, n+10, n+20... dark bands respectively by adjusting fine adjustment screw. from this the width of 15 dark bands is determined and hence the bandwidth β is calculated. The distance b/w the rubber band and wire is measured using the travelling microscope. The wavelength (λ) of sodium light iii, To measure the distance b/w the rubber band and given wire

LC = 0.001 cm

position	microscope reading				$\lambda = H_2 - H_1$
	MSR	VSC	VSR = VSC × LC	TR = MSR + VSR	cm
Unit	cm	div	cm	cm	
Rubber band Given wire				.	3.42

iv, calculation:-

The mean bandwidth (β) = 0.076 cm.

= 0.076×10^{-2} m

The dis b/w the rubber band and given wire } l = 3.42 cm

= 3.42×10^{-2} m

The wavelength of sodium light $\lambda = 5893 \times 10^{-10}$ m

The thickness of the given wire

$$t = \frac{\lambda l}{2\beta} \text{ meter}$$

$$= \frac{5893 \times 10^{-10} \times 3.4 \times 10^{-2}}{2 \times 0.076 \times 10^{-2}}$$

= 1.70.391 × 10^{-10} metre

20036.2

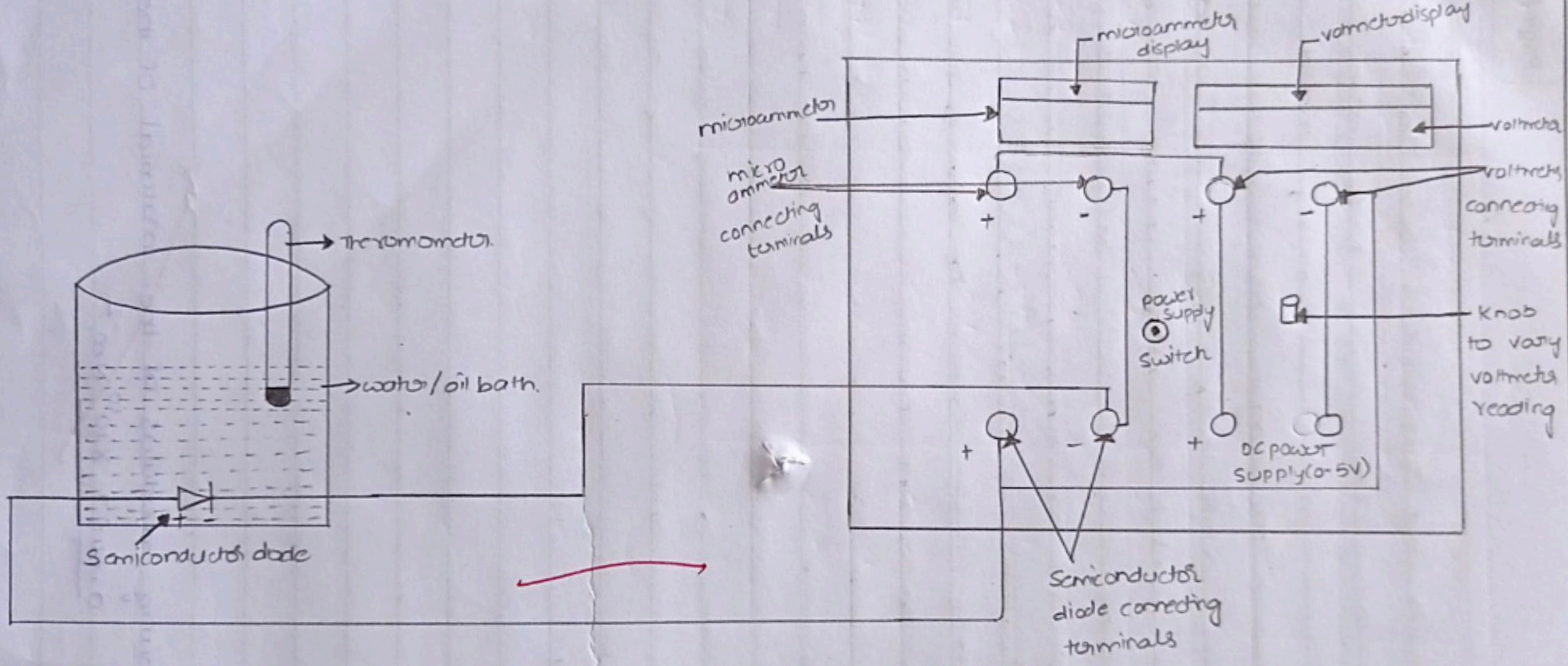
0.03 × 1
5893 × 10^{-10}
5893.00 / 45

is taken from the data given at the end of book
The thickness of given thin wire is calculated using formula

Result:-

The thickness of the given thin wire = 7.70 [illegible] metre
391×10^{-5}

fig(a): Band gap determination- circuit diagram.



Red terminals- positive terminals

Black terminals - negative terminals

Expt. No. 08

Date : 24-04-19.

DETERMINATION OF BAND GAP OF A SEMICONDUCTING MATERIAL

Aim:-

To determine the band gap of a given semiconducting material

Apparatus required:-

* A kit provided with dc power supply (0-5v), a voltmeter
* A micro-ammeter, connecting terminals
* A given semiconductor diodes.
* A water or oil bath with heating arrangment
* A thermometer
* A connecting wires

formula:-

The band gap of the given semiconducting material

$E_g = 0.198 \times$ slop of the plot of $\log I_g$ versus $10^3/T$ eV

Explanation of symbols :-

Symbol	explanations	unit
I_g	Saturation Reverse current	micro-ampere
T	Absolute temperature of water or oil bath	Kelvin

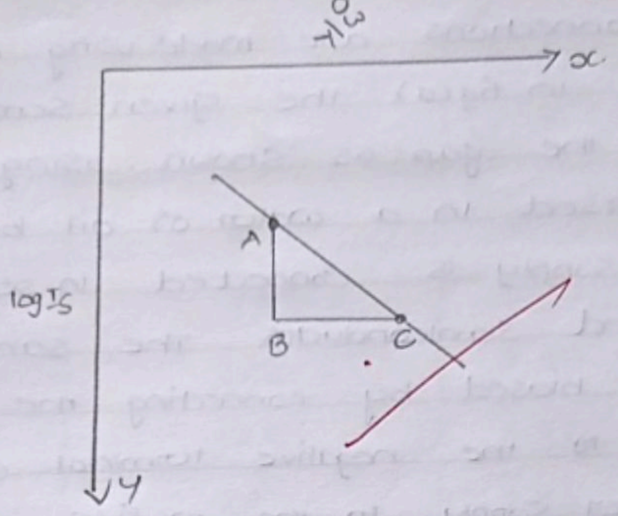
1, observations

S NO	Temp of water/oil bath	Temp of water/oil bath ($0^\circ C + 273$) = T	$10^3/T$	I_S	$\log I_S$
unit	$^\circ C$	K	K^{-1}	μA	
1.	85	358	2.79	120.9	-3.917
2.	84	357	2.80	115.4	-3.937.
3	83	356	2.80	109.5	-3.960
4	82	355	2.81	104.1	-3.980
5	81	354	2.82	100.1	-3.999
6	80	353	2.83	95.8	-4.018
7	79	352	2.84	90.8	-4.041
8	78	351	2.85	85.9	-4.066
9	77	350	2.86	80.8	-4.092
10	76	349	2.87	71.3	-4.111

procedure:-

The connections are made using connecting wires as shown in fig(a). The given semiconductor is connected in the gap as shown. using conning wires and immersed in a water or oil bath. The given dc powdy supply is connected in series with a microammeter and semiconductor. The semiconductor diode is reverse biased by connecting the positive side of the power supply to the negative terminal and the negative side of the power supply to the positive terminal of the diode. A thermometer is placed well within the water/oil bath to measure the temperature of the semiconductor diode.

A water/oil bath is heated upto the temperature 75°c. The heater is switched off. The DC power supply is switched on and the knob is adjusted to have any value between 0.5V and 2.0V in the voltmeter depending upon the type of semiconducting material. when the water/oil bath cools to the temperature 70°c the microammeter reading is noted. The micro ammeter reading is called reverse saturation current I_s. The microammeter readings are noted when the temperature of water/oil bath cools to the temperature 65°c, 60°c, 55°c, 50°c successively and the readings are tabulated. A graph is taken taking $\log I_s$ along y-axis and $10^3/T$ along x-axis. The plot will be a straight line as explained below. The following Equations shows the variations of reverse saturation current (I_s) with respect to temperature(T) ii, The graph between $10^3/T$ and log Is.



iii, calculation:-

$$Eg = 0.198 \times 1.9$$
$$= 0.3762\ eV$$

$$I_S = A \exp\left[-E_g/KT\right]$$

where A is a constant, E_g is band gap of semi conducting material and K is Boltzman constant.

Taking log on both sides.

$$\ln I_S = \ln A - E_g/KT$$

$$2.303 \log I_S = 2.303 \log A - E_g/KT$$

Dividing throughout by 2.303

$$\log I_S = \log A - \frac{E_g}{2.303KT}$$

The gap between valence band and conduction band of a semiconducting material is known as band gap (E_g) and it is expressed in eV. since $K = 1.38 \times 10^{-23}$ J/K its value is to be divided by electronic charge $e = (1.6 \times 10^{-19}$ coloumb) to convert the unit J/K into eV/K

$$\log I_S = \log A - \frac{E_g}{\frac{2.303 \times 1.38 \times 10^{-23} \times T}{1.6 \times 10^{-19}}}$$

$$\log I_S = \log A - \frac{E_g \times [10^3/T]}{0.198}$$

The above relation shows that the graph between $\log I_S$ and $10^3/T$ is a straight line

Hence, the slope of straight line $= \frac{E_g}{0.198}$.

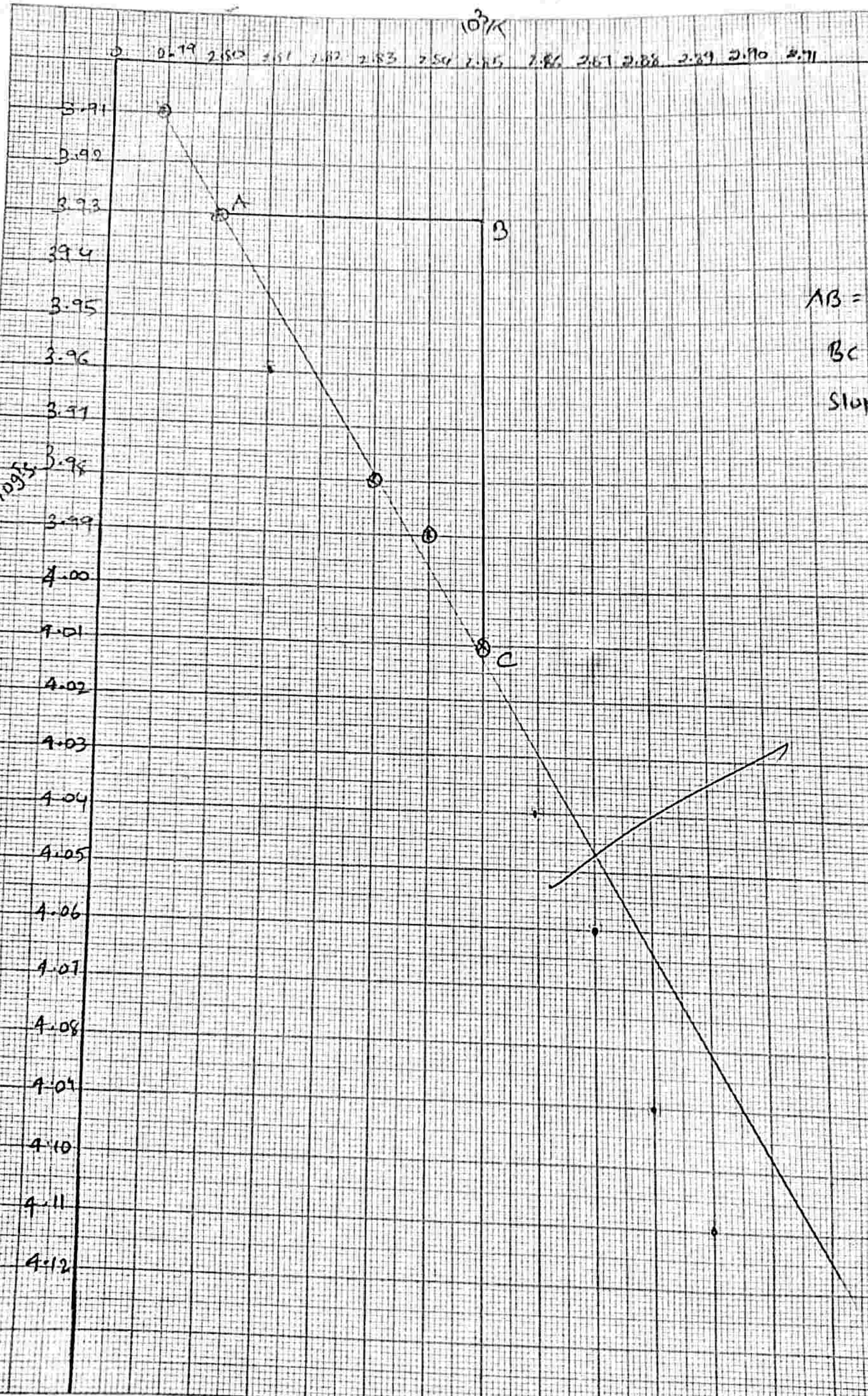
$\therefore E_g = 0.198 \times$ Slope of straight line.

The band gap is thus determined by calculating the Slop of straight line.

Expt. No.

A graph between $10^3/T$ and log Is.

SN	Temperature of water/oil bath	Temperature of water/oil bath (C+273)=T	$10^3/T$	Is	log Is.
unit	°C	K	K^{-1}	$\times 10^{-6}$ A	
1.	805	358	2.79	120.9	-3.917
2.	84	357	2.80	115.4	-3.937
3.	83	356	2.80	109.5	-3.960
4	82	355	2.81	104.1	-3.980
5	81	354	2.82	100.1	-3.999
6	80	353	2.83	95.8	-4.018
7	79	352	2.84	90.8	-4.041
8	78	351	2.85	85.9	-4.066
9	77	350	2.86	80.8	-4.092
10	76	349	2.87	71.3	-4.111



Scale

x-axis = 1cm = 0.01 unit

y-axis = 1cm = 0.01 unit

AB = 4.018 ~ 3.998

BC = 0.83 ~ 2.82

Slope = $\frac{AB}{BC}$

= $\frac{0.014}{.01}$

= 1.9

Expt. No.

Date :

Result:-

The band gap is given semiconducting material

= 0.3762 eV

Completed

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